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Kate Walsh
Columbia University, klw2153@columbia.edu

David DiLillo
University of Nebraska-Lincoln, ddilillo@unl.edu

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Ovulation, In Vivo Emotion Regulation Problems, and Sexual Risk Recognition Deficits

Kate Walsh, PhD[1]; David DiLillo, PhD[2]

1. Department of Epidemiology at Columbia University, New York, New York.
2. Department of Psychology at the University of Nebraska–Lincoln in Lincoln, Nebraska.

Corresponding author – Kate Walsh, PhD, Department of Epidemiology, Columbia University, 722West 168th Street, New York, NY 10032, USA, email klw2153@columbia.edu

Abstract
Objective: To examine associations between menstrual cycle phase, negative mood, sexual risk recognition deficits (assessed via an analogue risk vignette), and in vivo emotion dysregulation. *Participants:* Participants were 714 college women recruited between February 2007 and December 2009. *Methods:* Participants were randomly assigned to a negative or neutral mood induction and instructed to identify sexual risk during an audiotaped sexual coercion vignette. Participants reported menstrual cycle information, in vivo emotional nonacceptance, and attention during the vignette. *Results:* In the negative mood condition, ovulation was associated with longer risk recognition latencies relative to the luteal and follicular phases of the menstrual cycle. Increased in vivo emotional nonacceptance and decreased attention to the vignette mediated associations between ovulation and risk recognition deficits in the negative mood condition. *Conclusions:* Sexual assault risk reduction programs could provide psychoeducation regarding negative mood during ovulation and emphasize emotional acceptance and attention to external stimuli when distressed.

Keywords: emotional regulation, ovulation, sexual risk regulation

Sexual assault has been associated with sequelae such as anxiety, depression, posttraumatic stress disorder, substance abuse, interpersonal difficulties, and serious health problems including human immunodeficiency virus.[1] These negative outcomes coupled with the high public health costs, including law enforcement, medical, mental health, and victim advocate services, highlight the importance of better understanding the risk factors for this

significant societal problem.[2] College women represent an important subgroup in which to study these risk factors, as nearly 20% will report a rape or sexual assault during her life course.[3] Although the responsibility for an assault is the perpetrator's alone, understanding how victim variables might contribute to sexual assault risk may illuminate important avenues for prevention work. One variable that may increase risk for sexual assault is the inability to recognize risk cues in dangerous interpersonal situations.[4,5] Using analogue vignettes that depict a dating scenario or other sexually coercive encounter, prospective studies have found that women who take longer to identify sexual risk are more likely to experience subsequent sexual victimization.[6] Thus, impaired risk recognition may be a critical precursor to sexual assault that is worthy of scientific inquiry.

Although many factors, including sexual victimization history[5] and alcohol use,[7] have been examined in relation to sexual risk recognition problems, not all studies have found consistent associations,[8] suggesting that other factors also may contribute to risk recognition deficits. Although largely unexplored as a predictor of sexual risk recognition problems per se, menstrual cycle has been posited to play a role in reducing women's sexual risk behaviors, particularly near the time of ovulation.[9,10] This work used retrospective self-report data to demonstrate that women in the ovulatory phase of the menstrual cycle reported engaging in fewer sexual risk behaviors in the previous 24 hours when compared with other phases of the menstrual cycle.[9,10] Theorists suggest that this reduction in risk behaviors near ovulation may reflect an evolutionary means of enhancing mate selection and propagating reproductive fitness by reducing the likelihood of rape (for review see McKibbon and Shackelford[11]). Consistent with this notion, studies have found increased handgrip strength among ovulating women while reading an essay depicting a potential sexual risk scenario (e.g., a man approaching a woman as she is going to her car late at night[12]), and women rate men's mating behaviors as more sexually coercive during ovulation relative to other phases of the menstrual cycle.[13] Further, in the presence of threatening-looking confederates, ovulating women tend to sit farther away than do nonovulating women.[14] Thus, it is plausible that a biological adaptation exists to aid women in more expediently identifying sexual risk during the ovulatory phase of the menstrual cycle. At the same time, some data run counter to the notion that rape is less common during ovulation (for review see Fessler[15]). For example, a study that retrospectively examined the menstrual cycles of women who reported a rape to the police found that ovulation was associated with the *highest* risk for rape.[16] Thus, although the preponderance of theory and data suggests that ovulation may function as a protective factor for rape, the literature regarding this association is rather mixed and warrants further study.

Recent research suggests that person-level variables should be considered in combination with situational variables to best understand sexual risk–taking behavior.[17] One such variable, negative mood (often measured as response to a mood induction), has been associated with poorer responses to complex social interactions that require elaborate processing and responses.[18] For instance, laboratory-induced sadness (vs happiness) has been linked to more evasive and equivocal responses to stress-evoking interpersonal situations, an effect that is heightened for high-conflict interpersonal situations.[19] It follows that laboratory-induced negative mood may increase problems with sexual risk detection during a stress-evoking analogue dating vignette. Further, sensitivity to negative stimuli may

be heightened during the ovulatory phase of the menstrual cycle, as daily diary studies have documented increased self-reported negative affect among women in the ovulatory phase when compared with women in other phases of the menstrual cycle.[20] Although research suggests that ovulation may be associated with increased protective behaviors relative to other phases of the menstrual cycle,[12] ovulating women who receive a negative mood induction may have particular problems with sexual risk detection when compared with those who are not ovulating or in a negative mood.

To better understand how mood state may increase problems with sexual risk recognition, it is necessary to consider the manner in which women actually regulate emotions (i.e., identify, experience, and manipulate emotions) in sexual risk–specific contexts. Using a written vignette, sexually victimized women with emotion regulation problems took longer to report that they would leave a risk sexual scenario.[21] One explanation for this finding is that women who are focused internally on minimizing unpleasant emotional states may overlook key environmental information that signifies danger. This notion is consistent with theoretical models that highlight the role of attention in the emotion regulation process,[22] and suggests that diminished attention to risk cues may result in delays in detecting risk. In addition to problems with attention, which may occur early in the emotion regulatory process, there is evidence that emotional nonacceptance, a facet of emotion dysregulation that reflects secondary appraisals of emotions as "bad" or "wrong," may be associated with increased problems in functioning. Indeed, laboratory studies examining responses to psychologically distressing tasks highlight the importance of emotional nonacceptance in predicting increased problems with performance on a distress tolerance task.[23] In the case of sexual assault risk, those who are unwilling to accept their own negative emotions, including fear or distress, may be delayed in their ability to identify risk and escape from the situation. Although this relationship has yet to be examined explicitly, studies suggest that individuals who use less adaptive emotion regulation strategies tend to be less assertive during stressful interpersonal conflicts,[19] which lends credence to the notion that maladaptive emotional processing in the moment may hinder awareness of and responses to a risky sexual encounter.

Drawing on the above findings, the purpose of this study was to examine associations between menstrual cycle phase, negative mood condition, in vivo emotion regulation problems, attention, and sexual risk recognition deficits. The following hypotheses were tested:

1. Based on the mixed findings reviewed above, two competing possibilities regarding the potential impact of ovulation on risk recognition abilities were tested. First, given findings that ovulation is associated with increased rape-related protective behaviors, women in the ovulation phase were expected to report *shorter* sexual risk recognition latencies compared with those in other phases of the menstrual cycle. Alternatively, data linking ovulation to increased sexual risk taking suggest that ovulation may actually contribute to *longer* latencies in recognizing sexual risk. Each of these alternatives was tested in the present study.

2. In light of past work showing that negative mood interferes with the processing of complex social cues, participants undergoing a negative mood induction were expected to report longer risk recognition latencies during a sexual assault risk vignette.
3. The potential interactive effects of ovulation and negative mood on risk responding also were examined. Again, the mixed literature regarding ovulation's impact on risk recognition led to two plausible hypotheses. If, as the preponderance of literature suggests, ovulation serves a protective function, that effect may be largely offset by the induction of negative mood, resulting in little if any decrements in risk recognition compared with nonovulating women without a mood induction. On the other hand, if ovulation inhibits risk recognition, the addition of a negative mood induction should exacerbate that effect, further extending risk recognition latencies in response to the vignette.
4. In vivo emotional nonacceptance as well as reduced attention to the vignette were expected to mediate associations between menstrual phase and risk recognition latencies in the negative mood condition.

Methods

Participants

Participants were 714 undergraduate women with a mean age of 19.6 (*SD* = 1.9) recruited to participate in a laboratory study between February 2007 and December 2009. Approximately 75.5% of participants reported their ethnicity as European American, 5.2% African American, 7.4% Hispanic/Latina, 7.8% Asian, 1.0% Native American, 0.6% Hawaiian/Pacific Islander, and 2.5% other. Most participants (92.5%) had never been married, but 2.5% were married, 4.6% were cohabitating, and 0.5% were divorced or separated.

Measures

Menstrual Cycle Phase

Participants were provided with a calendar for the last year and asked to record the first date of their last period. Consistent with prior studies in this area,[9,10] the forward cycle method was used to count from the first day of the last reported period to determine the participant's menstrual cycle phase at the time of the study. Days 0–12 were classified as the follicular phase, days 13–17 were classified as the ovulatory phase, and days 18–28 were classified as the luteal phase.

Difficulties in Emotion Regulation Scale (DERS)[24]

The DERS is a 36-item self-report instrument that assesses six factor–analytically-derived facets of emotion regulation: nonacceptance of emotional responses, difficulties engaging in goal-directed behavior, impulse control difficulties, lack of emotional awareness, limited access to emotion regulation strategies, and lack of emotional clarity. Participants respond to items on a 5-point scale anchored from 1 = *almost never* to 5 = *almost always*, with higher

scores reflecting greater emotion regulation difficulties. Consistent with other studies examining in vivo emotion regulation,[25] the present study used 25 items from the DERS that were slightly modified to apply specifically to emotion regulation during the vignette (e.g., "When I was upset during the vignette, I became angry with myself for feeling that way"). Prior studies also show the DERS to have good internal consistency and test–retest reliability for the subscales.[24] In the current study, hypotheses centered on the emotional nonacceptance subscale of the DERS (α = .85).

Positive and Negative Affective Schedule (PANAS)[26]

The PANAS is a 20-item self-report measure consisting of adjectives that describe two general mood dimensions: positive and negative affect. Participants rate each mood adjective on a 5-point Likert scale ranging from 0 (*very slightly*) to 4 (*extremely*) regarding their current emotional state. In undergraduate samples, internal consistency coefficients for the positive and negative affect subscales are .88 and .85, respectively. Further, the PANAS has been shown to have good convergent and discriminant validity.[26] The PANAS was administered before and after the mood induction to ascertain that it yielded the desired effects and to evaluate whether menstrual cycle was associated with differences in the ability to achieve negative affect during the mood induction. Alpha for the negative affect subscale pre–mood induction was .88 and post–mood induction was .91.

Attention

Following the vignette, participants were asked to rate their attention to the vignette on a Likert-type scale ranging from 1 = 0% or "did not pay attention to any part of the vignette" to 10 = 100% or "attended to the entire vignette."

Stimuli

Sexual Assault Vignette[27]

The vignette is a 370-second audio recording of a dating interaction between a man and woman that concludes in forcible rape. The man's tactics to obtain sexual intercourse increase in intensity throughout the vignette, progressing from verbal pleas to verbal threats and physical force. In response to these tactics, the woman's refusals increase in intensity, beginning with reasoning and refusing and culminating in pleading and crying. Although typically used as a continuous measure, there are 6 distinct portions of the vignette: mutual interaction (0–74 seconds), polite refusals (75–97 seconds), verbal refusals and apologies by the man (98–136 seconds), verbal pressure and refusals (137–179 seconds), verbal threats and adamant refusals (180–276 seconds), and forced sex (277–370 seconds). The vignette has 2- week test–retest reliability of .87.[28] In prior studies with this vignette, data suggest that participants rate the audio scenario to be quite realistic (average rating of 84.11 on a 100-point scale).[4] To ensure that curiosity regarding the outcome of the vignette did not bias risk recognition responses, participants were told in advance that they could listen to the remainder of the vignette after indicating that the man had gone too far.

Mood Induction

Participants were randomly assigned to a negative or neutral mood induction. Consistent with previous studies inducing general negative affect,[29] a brief (4.5-minute) film clip that depicts a Russian Roulette scene from the movie *The Deer Hunter* was used. The most common negative emotion adjectives reported in response to the clip are distressed, upset, anxious, and nervous, which collectively reflect general negative emotions.[29] Prior exposure to the film clip was assessed to ensure that previously exposed participants did not differ with respect to ability to attain negative mood. Only 2% of participants (n = 14) reported seeing the film prior to the study. To draw conclusions about the effects of mood states on risk responses, participants assigned to the "neutral" mood condition viewed a 4.5-minute film depicting scenery from a natural park in Alaska that has been shown to induce a mildly pleasant emotional state.[30]

Procedures

Participants were recruited from undergraduate psychology classes using an online tool, Experimetrix.com, and received course credit for participating in a single laboratory session. To increase sample diversity, ethnic minority women also were recruited via flyers posted throughout campus, online advertisements, student newspaper advertisements, and in-person solicitation in Ethnic Student Association meetings and courses. In all cases, participants were invited to participate in a study examining "the relationship between life experiences, dating relationships, and sexual attitudes." After obtaining written informed consent, participants completed the PANAS, listened to the sexual assault vignette, and completed a second PANAS. They also completed the DERS anchored to the vignette and a single item querying about attention to the vignette. All procedures were approved by the institutional review board of a large public university.

Results

Missing Data

Twenty-eight-day menstrual cycle phase data were available for 523 participants. When asked to provide the first day of their last period, 109 (14.9%) provided a date within the past year that did not fall within the typical 28-day cycle and 93 (13.9%) provided a date that was not within the past year. Those who were excluded from analyses did not differ significantly from those included on risk recognition, in vivo emotion dysregulation, or in vivo attention to the vignette. Missing data were handled via listwise deletion in descriptive and bivariate analyses.

Manipulation Check

To ensure that the mood induction produced negative emotion, a negative emotion change score was computed by subtracting the PANAS pre score from the PANAS post score. Using a paired-samples t test, mean PANAS negative mood score for the negative mood condition changed from 17.3 (SD = 7.3) prefilm to 24.0 (SD = 9.1) postfilm, $t(327) = -12.7$, $p < .001$. Further, a comparison of postfilm mean PANAS negative mood scores for those

in the negative and neutral mood conditions revealed a statistically significant difference, $M_{error} = 19976.2$, $F(1, 654) = 399.7$, $p < .001$, such that those in the negative condition reported a mean postfilm PANAS negative mood score of 24.0 ($SD = 9.1$) compared with a mean of 12.9 ($SD = 4.2$) for those in the neutral mood condition. This manipulation check suggests that the negative mood film induced the expected changes in negative affect.

Descriptive Statistics

Correlations between study variables are presented in table 1. The ovulatory phase of the menstrual cycle was associated with decreased attention to the vignette; emotional nonacceptance during the vignette was associated with longer latency to recognize risk, decreased attention to the vignette, and a pre–post vignette increase in negative affect; decreased attention during the vignette was associated with longer risk recognition latencies as well. For those who provided valid 28-day menstrual cycle data at the time of study participation, 272 (52.0%) were in the follicular phase of the menstrual cycle, 48 (9.2%) were in the ovulatory phase, and 203 (38.8%) were in the luteal phase. The mean risk recognition latency for the sample was 106.6 ($SD = 61.8$) seconds, which equates to the portion of the vignette when the woman is verbally refusing advances and the man is apologizing for his behavior. The mean in vivo nonacceptance score was 7.0 ($SD = 2.5$), and the mean in vivo attention score was 9.2 ($SD = 1.4$). Table 2 contains mean scores for each study variable by phase of the menstrual cycle. Women in the ovulatory phase of the menstrual cycle paid significantly less attention during the vignette; however, menstrual cycle phase was not associated with significant mean differences in other variables of interest.

Hypothesis 1: Ovulation Will Be Associated with Shorter Risk Recognition Latencies When Compared with Other Phases of the Menstrual Cycle

Analysis of variance (ANOVA) revealed that menstrual cycle phase did not have a main effect on risk recognition latency, $F(1, 497) = 1.4$, $p = .26$. Means and standard deviations are presented in table 2.

Hypothesis 2: Negative Mood Would Be Associated with Longer Risk Recognition Latencies

There was not a main effect for mood condition, $F(1, 691) = .03$, $p = .86$. The mean latency for the negative mood condition was 106.2 ($SD = 57.8$) seconds and for the neutral condition mean latency was 106.9 ($SD = 65.4$) seconds.

Table 1. Correlations between Study Variables

Variable	Ovulation	Negative mood condition	DERS Non-acceptance	Risk recognition	Vignette attention	Vignette Δ negative affect
Ovulation	1.0	.006	.06	.08	–.24***	.01
Negative mood condition		1.0	.02	.006	–.05	.53***
DERS Nonacceptance			1.0	.23***	–.18**	.19***
Risk recognition				1.0	–.18**	–.03
Vignette attention					1.0	–.04
Vignette Δ negative affect						1.0

Note: Ovulation (1) vs anovulation (0); negative mood (1) vs neutral mood (0). DERS Nonacceptance = Difficulties in Emotion Regulation Scale Emotional Nonacceptance; Risk recognition = risk recognition latency; Vignette Δ negative affect = change in negative affect during the vignette.

$^{**}p < .01$; $^{***}p < .001$.

Table 2. Means (Standard Deviations) for Study Variables by Menstrual Phase

Variable	Follicular	Ovulatory	Luteal	*F*	*p*
Negative affect pre-mood film	16.9 (6.8)	15.9 (6.1)	16.4 (7.2)	.48	.62
Vignette Δ negative affect	.57 (8.3)	1.2 (7.9)	1.0 (8.5)	.22	.80
DERS Nonacceptance	6.9 (2.4)	7.5 (3.1)	6.9 (2.2)	.42	.66
Vignette attention	9.3 (.96)[a]	8.0 (3.3)[b]	9.4 (1.3)[a]	6.0	.003
Risk recognition	103.6 (56.9)	122.6 (73.6)	103.7 (55.5)	1.5	.22

Note: Different superscripts within a row represent statistically significant differences based on follow-up least significant difference pairwise comparisons. DERS Nonacceptance = Difficulties in Emotion Regulation Scale Emotional Nonacceptance.

Hypothesis 3: Negative Mood Would Be Associated With Longer Risk Recognition Latencies for Women in the Ovulatory Phase Compared With Women in Other Phases

When a 3 (menstrual cycle) × 2 (mood condition)ANOVA was conducted, mood condition, $F(1, 497) = 4.9$, $p < .05$, and the interaction between mood condition and menstrual cycle phase, $F(2, 497) = 3.6$, $p < .05$, were significantly associated with risk recognition latency. More specifically, women in the ovulatory phase who were also in a negative mood took significantly longer to identify risk when compared with women in other menstrual phases as well as those in the ovulatory phase who were in the neutral condition.

Hypothesis 4: In Vivo Emotional Nonacceptance and Attention Would Mediate Associations between Ovulation and Risk Recognition Latencies for Women in a Negative Mood

Baron and Kenny's causal steps,[31] which were used to determine mediation, require that the independent variable and mediator must be significantly associated and the mediator and the dependent variable must be significantly associated. Full mediation is established if the significant relationship between an independent and a dependent variable is reduced to nonsignificant in the presence of a mediator, and partial mediation is established if the relationship is reduced but remains statistically significant.[31] Given the similarity between

the follicular and luteal phases on the risk recognition variable, menstrual phase was recoded to ovulatory (days 13–17) versus nonovulatory (days 0–12 or 18–28) for mediation analyses. In the negative mood condition, full mediation criteria were met for emotional nonacceptance and attention during the vignette (see table 3). Models accounted for 11% and 15%, respectively, of the variance in risk recognition latency. None of the mediation criteria were met in the neutral mood condition.

Table 3. Emotional Nonacceptance and In Vivo Attention as Mediators in the Association between Menstrual Cycle Phase and Risk Recognition Latency

	Negative mood condition				Neutral mood condition			
Mediator	*B*	*SE*	*t*	*p*	*B*	*SE*	*t*	*p*
Direct effect of ovulation	50.4	15.8	3.2	.002	−5.0	14.7	−.34	.73
Nonacceptance on ovulation	1.95	.99	1.98	.05	−.35	.82	−.42	.67
Risk recognition on nonacceptance	6.5	2.2	2.9	.004	.29	2.7	.11	.92
Mediated effect of nonacceptance	44.4	24.1	1.8	.07	−1.5	25.0	−.06	.95
Attention on ovulation	−1.1	.58	−1.9	.05	−1.5	.52	−2.8	.006
Risk recognition on attention	−16.6	4.8	−3.4	.001	−.02	5.4	−.003	.99
Mediated effect of attention	42.8	27.7	1.5	.13	−9.9	29.6	−.34	.74

Comment

Difficulties recognizing sexual risk have been associated with an increased likelihood of experiencing sexual victimization over time[32] and therefore represent a potentially important intervention target in reducing victimization risk. However, risk recognition is a complex process likely to be influenced by multiple factors, which currently are not well understood. The present study is perhaps the first to examine both biological (i.e., menstrual phase) and situational factors (i.e., negative mood, emotion regulation, and attention in a sexually risky context) as predictors of sexual risk recognition deficits. Contrary to expectations, there were no main effects of menstrual cycle phase on risk recognition, nor did mood condition alone influence risk recognition. Rather, menstrual cycle phase and mood state interacted to influence risk recognition such that ovulation was associated with longer risk recognition latencies only in the negative mood condition. Thus, negative mood appears to enhance problems with risk detection among ovulating women.

The present laboratory findings conflict with some retrospective self-report research suggesting that ovulation is associated with decreased risk behaviors[9]; however, it is important to note that the current findings were specific to the negative mood condition, a factor that previously has not been considered. Thus, any vulnerability associated with ovulation appears contingent on exposure to negative stimuli. Further, it remains possible that women have developed a biological adaptation to avoid risky situations at or around ovulation, but due to emotion regulation problems and decreased attention associated

with ovulation, these women have difficulty identifying risk once they are in dangerous situations, particularly if they have been exposed to negative emotion eliciting stimuli.

Findings that real-time emotional nonacceptance and diminished attention each fully mediated associations between ovulation and risk recognition not only add to a growing theoretical and empirical literature highlighting problems associated with emotional nonacceptance,[27] but they are also novel in highlighting the role of diminished attention in contributing to increased problems with sexual risk detection. Women in the ovulatory phase of the menstrual cycle who are exposed to negative stimuli may not allow themselves to acknowledge or experience discomfort that signifies impending danger, resulting in a critical delay in risk recognition and, potentially, effective defensive behavior. Further, devoting cognitive resources to these negative secondary appraisals may divert attention from critical information in the environment that might be needed to make effective decisions about safety.

Limitations

Findings should be interpreted cautiously due to study limitations. Menstrual phase was derived from self-report data collected regarding the first day of the participant's last period. Although participants were provided with a calendar to aid in reporting this information, a significant proportion of women recorded a date that did not fall within the range that could be considered a "typical" menstrual cycle, and thus were excluded from analyses here. Although consistent with previous studies,10 the 28-day cutoff used to define a "typical" menstrual cycle is rather stringent, as cycles can range from 13 to 58 days.[33] Other reasons for responses outside of the 28-day range include hormonal contraceptive use and certain health conditions (e.g., polycystic ovarian syndrome) that can influence menstrual cycle regularity by preventing ovulation.[34] However, women who were excluded from these analyses did not differ on any of the mediators or outcomes examined here. Further, oral contraceptive use was not assessed, which is a limitation given that a substantial proportion of college women report oral contraceptive use,[35] and many previous studies have found protective effects for ovulation only among naturally cycling women.[9] However, the inclusion of women taking oral contraceptives would be expected to mask the ability to detect effects for ovulation. Here, findings emerged even with the presence of oral contraception in the sample, suggesting the possible robustness of these associations. Nonetheless, more systematic evaluation of menstrual cycle and contraceptive use, as well as actual measurement of corresponding hormones, should be the focus of future research. Further, although studies have found that impaired risk recognition prospectively predicts risk for sexual victimization, it is difficult to ascertain whether responses to an analogue vignette truly approximate participants' actual responses to a risky scenario. However, given the ethical concerns associated with exposing women to actual risky situations, vignettes measuring reaction time offer a more ecologically valid assessment of risk perception than simply querying participants about situations that they believe are risky. Nonetheless, future research should focus on developing new and innovative ways to measure sexual risk recognition (e.g., virtual reality).

Conclusions

Despite the limitations noted here, these findings suggest the possible value of prevention programs to address deficits in emotion regulation and sexual risk recognition. Results suggest that women experiencing negative affect while ovulating may have difficulties accepting negative emotions or attending to sexual risk situations, which, in turn, may impair risk recognition. Current risk reduction programs do not address emotion regulation[6]; thus, women may be unable to use the information they learn to identify risk in the face of an assault because they cannot cope effectively with negative emotions. One possibility suggested by these data is to tailor prevention programs to teach women to acknowledge and use negative emotions as information that might signify the presence of risk and a need to escape. Highlighting the functionality and protective value of acknowledging and experiencing emotions, even when hormones seem to be in flux, may help to diminish problems accepting emotions during risky sexual situations. Such programs could also teach women to refocus externally on their situation in times of distress to attend to important cues and respond adaptively.

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